Integrating Analysis in Warehouse Design Workflow

Steffen Schieweck

Tim Skrotzki

Martin Thormann

Prof. Leon McGinnis

Orlando, FL - May 2012

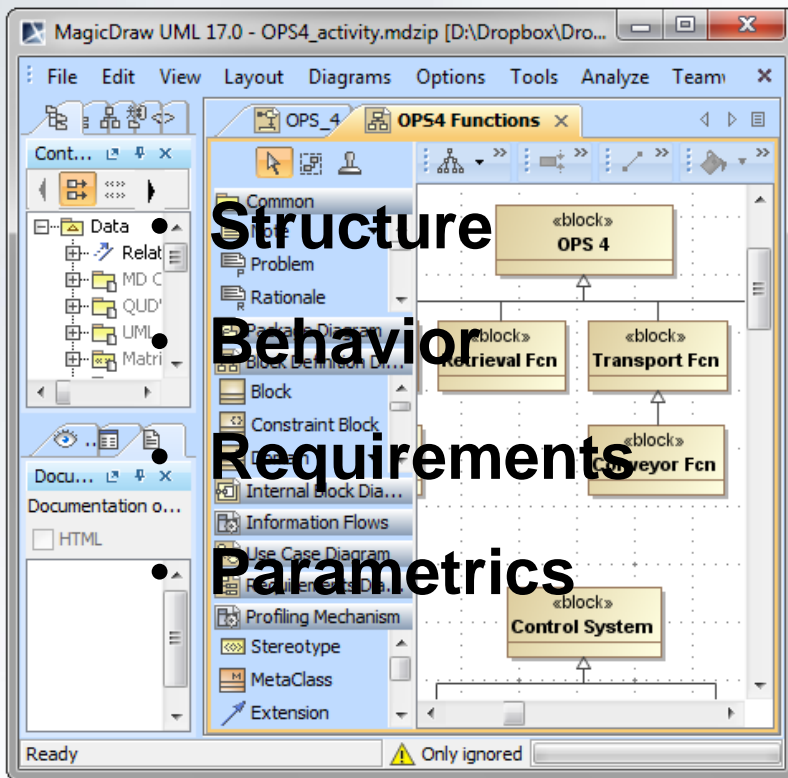**Georgia**Institute
of **Tech**nology®

Outline

1. Problem Description

2. Design Concept

3. Case: Order Picking System

4. Interfaces

5. Functional & Implementational Design

6. Conclusion & Future Work

Georgia Tech

Problem Description

- **<u>Warehouse design today:</u>**
  - Some design approaches based on empirical observations
  - Decisions based more on rules of thumbs than on analytic tools
  - → **Ad-hoc design process**, not generalizable
- **<u>The need:</u>** standardized design tool, which:
  - Connects design to analytic submodels
  - Provides useful design libraries
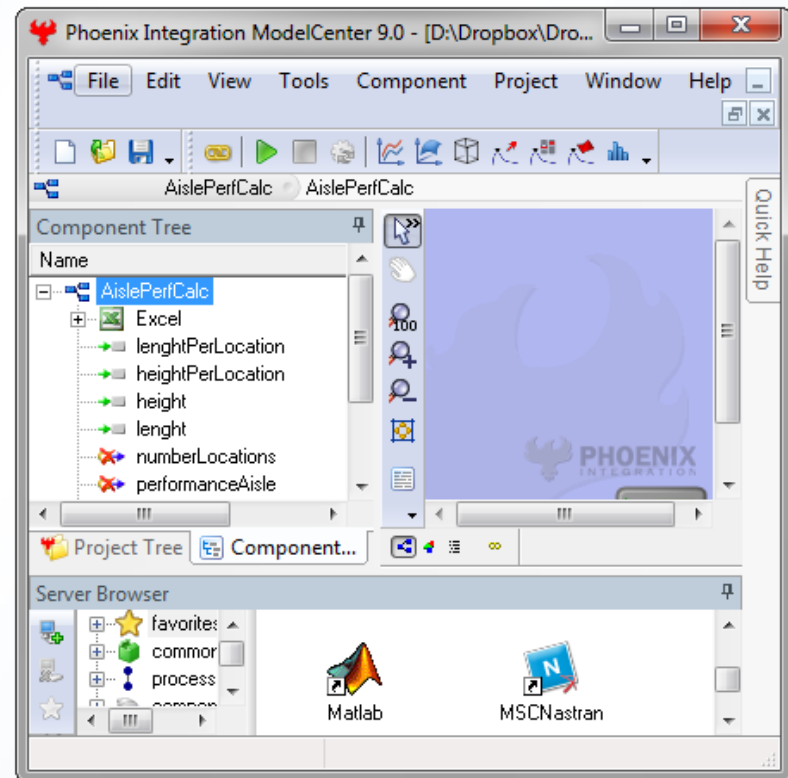 - Does not overly constrain design decisions

SysML and ModelCenter
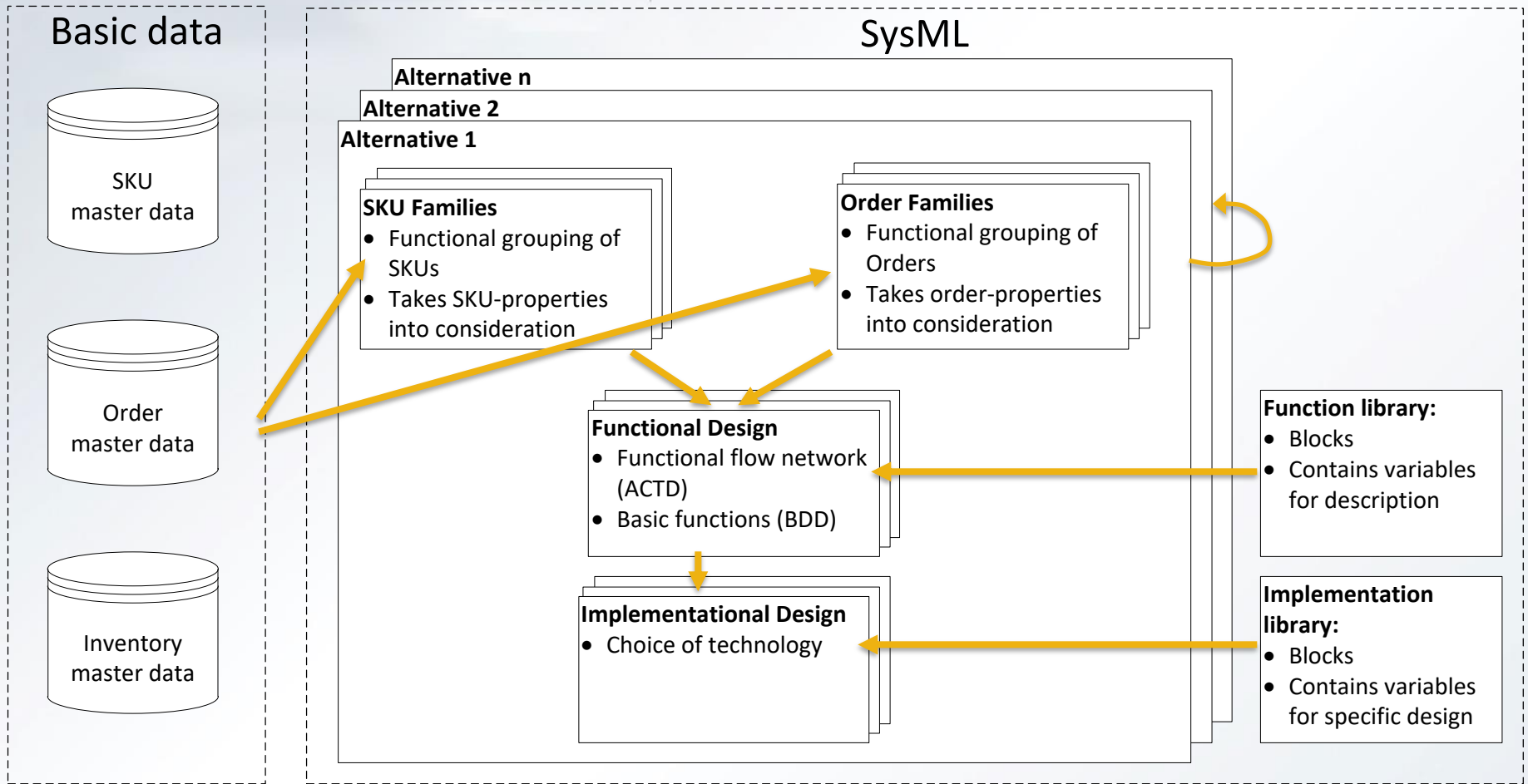
SysML

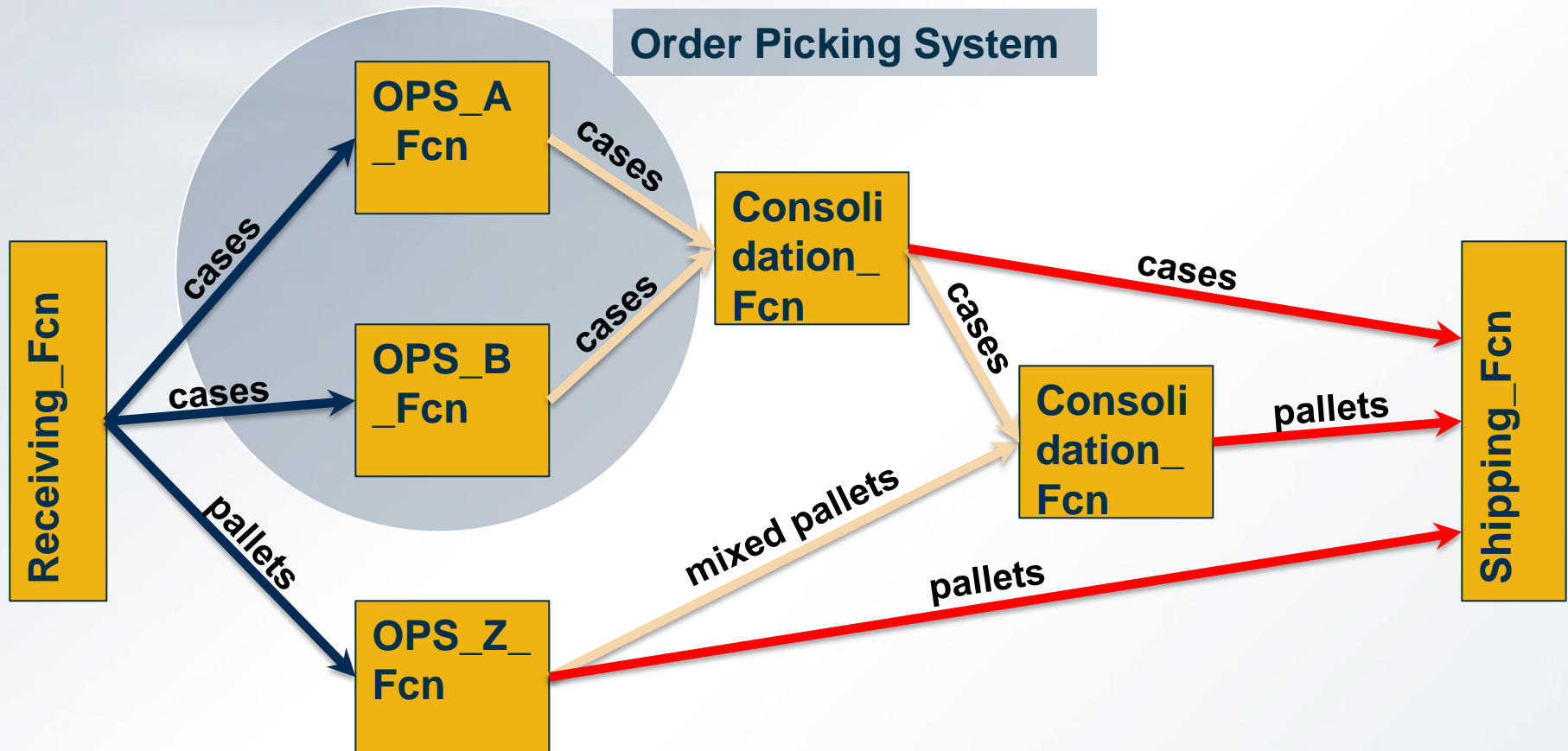- **Structure**
- **Behavior**
- **Requirements**
- **Parametrics**

ModelCenter

Georgia Tech

Design Concept

Basic data

SKU master data

Order master data

Inventory master data

SysML

Alternative n
Alternative 2
Alternative 1

SKU Families
- Functional grouping of SKUs
- Takes SKU-properties into consideration

Order Families
- Functional grouping of Orders
- Takes order-properties into consideration

Functional Design
- Functional flow network (ACTD)
- Basic functions (BDD)

Implementational Design
- Choice of technology

Function library:
- Blocks
- Contains variables for description

Implementation library:
- Blocks
- Contains variables for specific design

Georgia Tech

Functional Design

Order Picking System

Receiving_Fcn → OPS_A_Fcn (cases) → Consolidation_Fcn (cases) → Shipping_Fcn (cases)

Receiving_Fcn → OPS_B_Fcn (cases) → Consolidation_Fcn (cases)

Receiving_Fcn → OPS_Z_Fcn (pallets) → Consolidation_Fcn (mixed pallets) → Shipping_Fcn (pallets)

OPS_Z_Fcn → Shipping_Fcn (pallets)

SKU family | **Intermediate flow** | **Order family**

Georgia Tech

Order Picking System

Stacker crane

Order picker

Conveyor for order containers

Goods container

Order container

Zone 1   Zone 2   Zone n

Georgia Tech
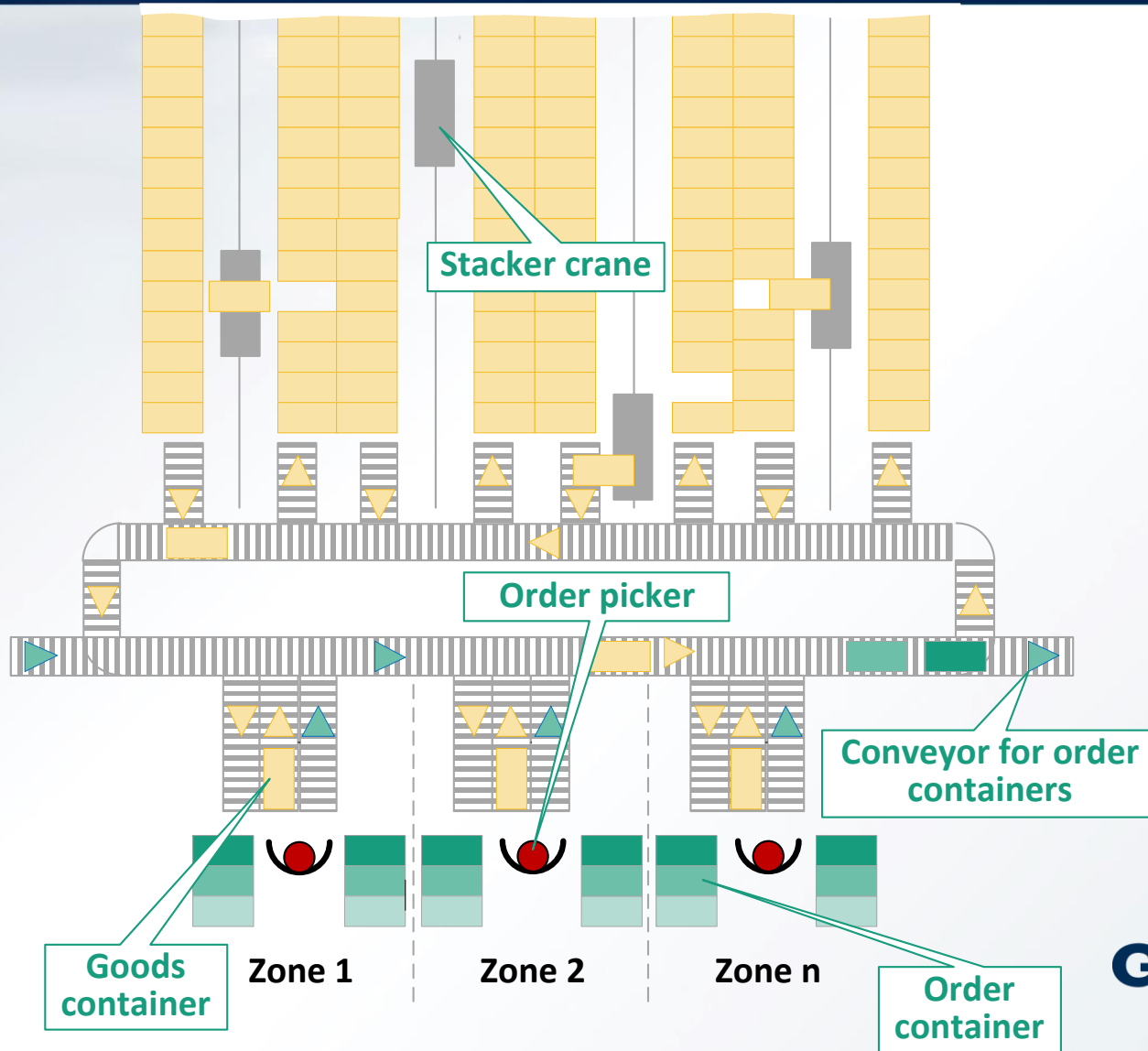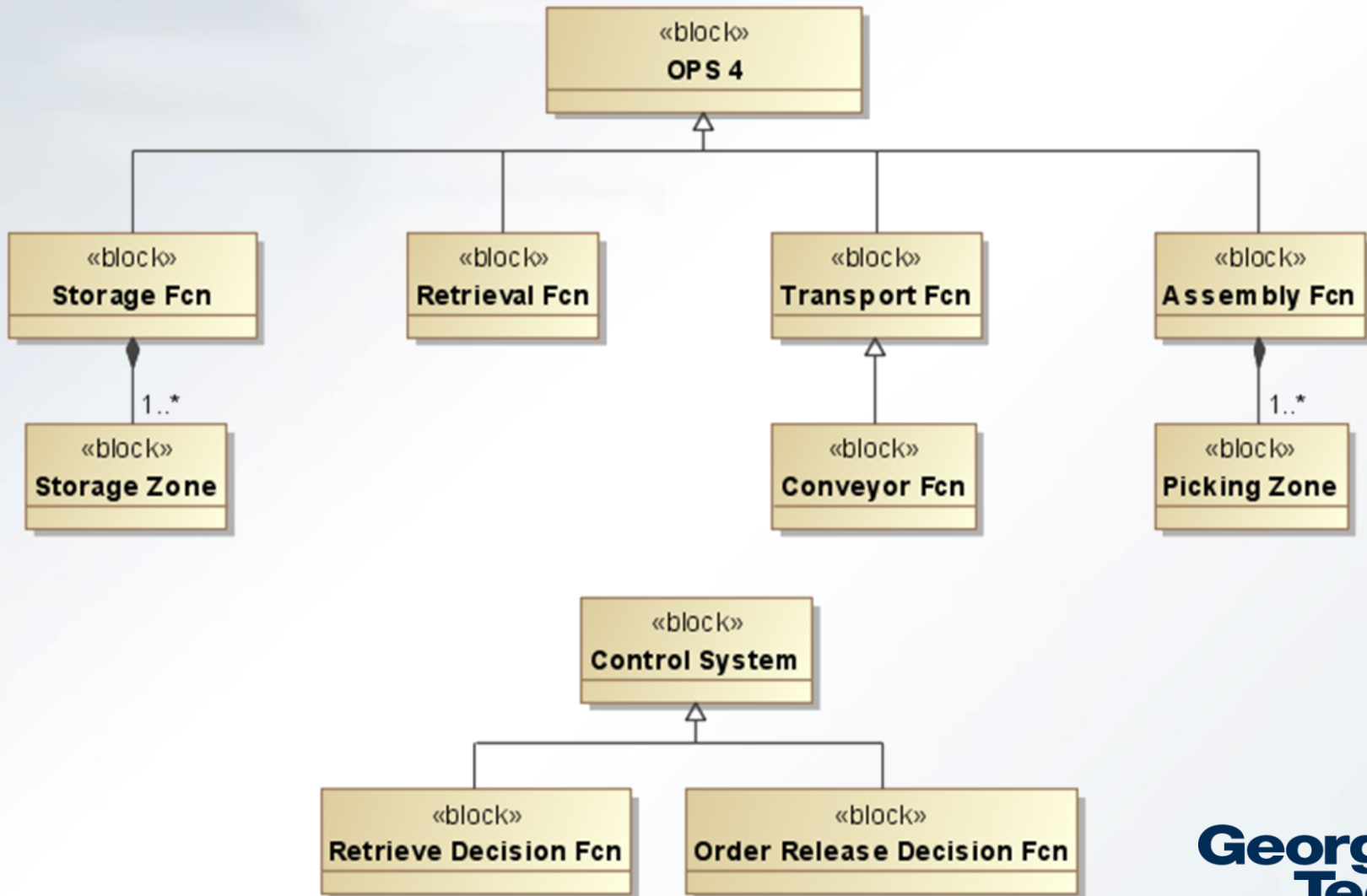
OPS Functions

OPS Functions
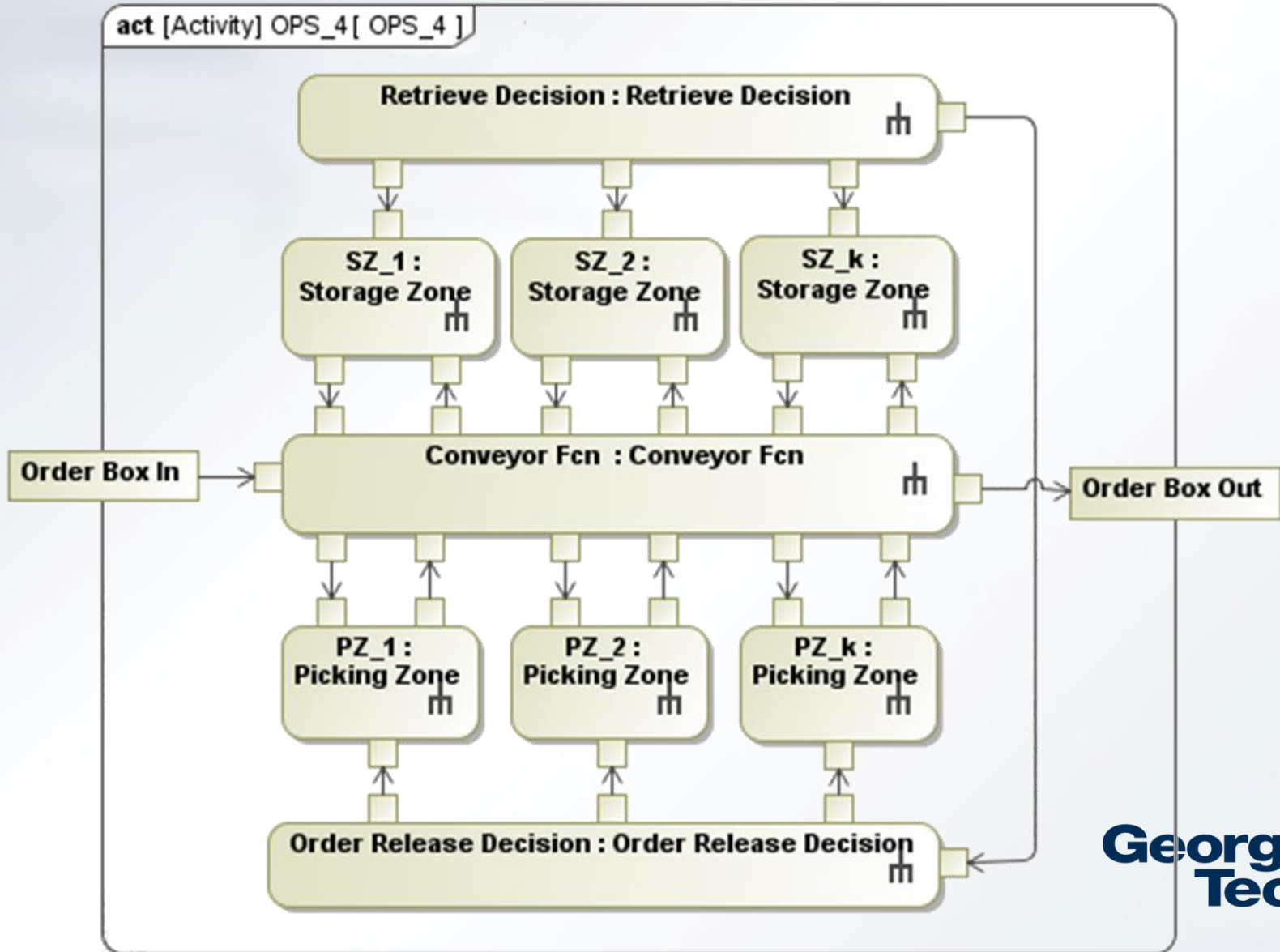
Connecting SysML with Solver

Instance Diagram

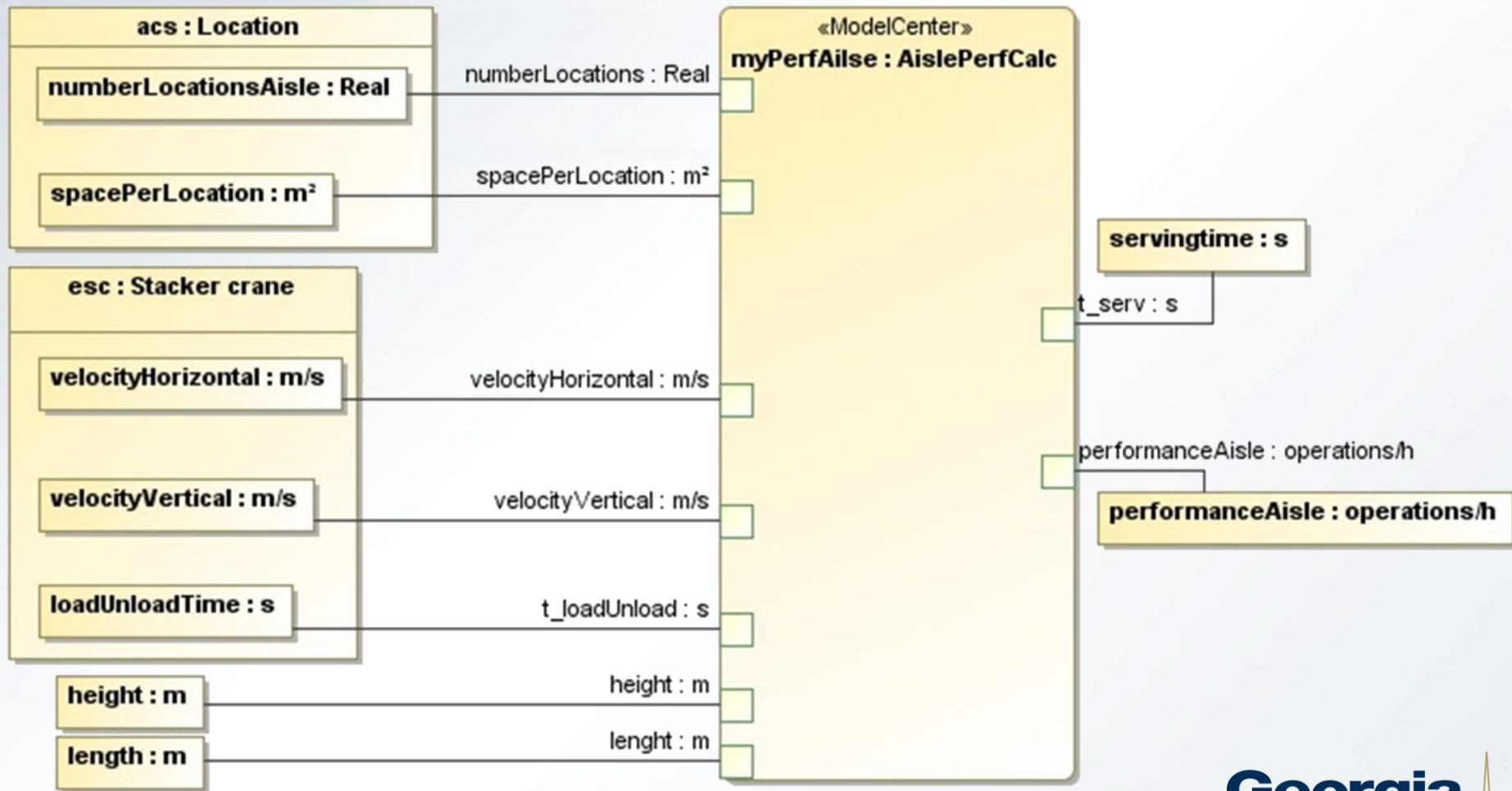**SysML**

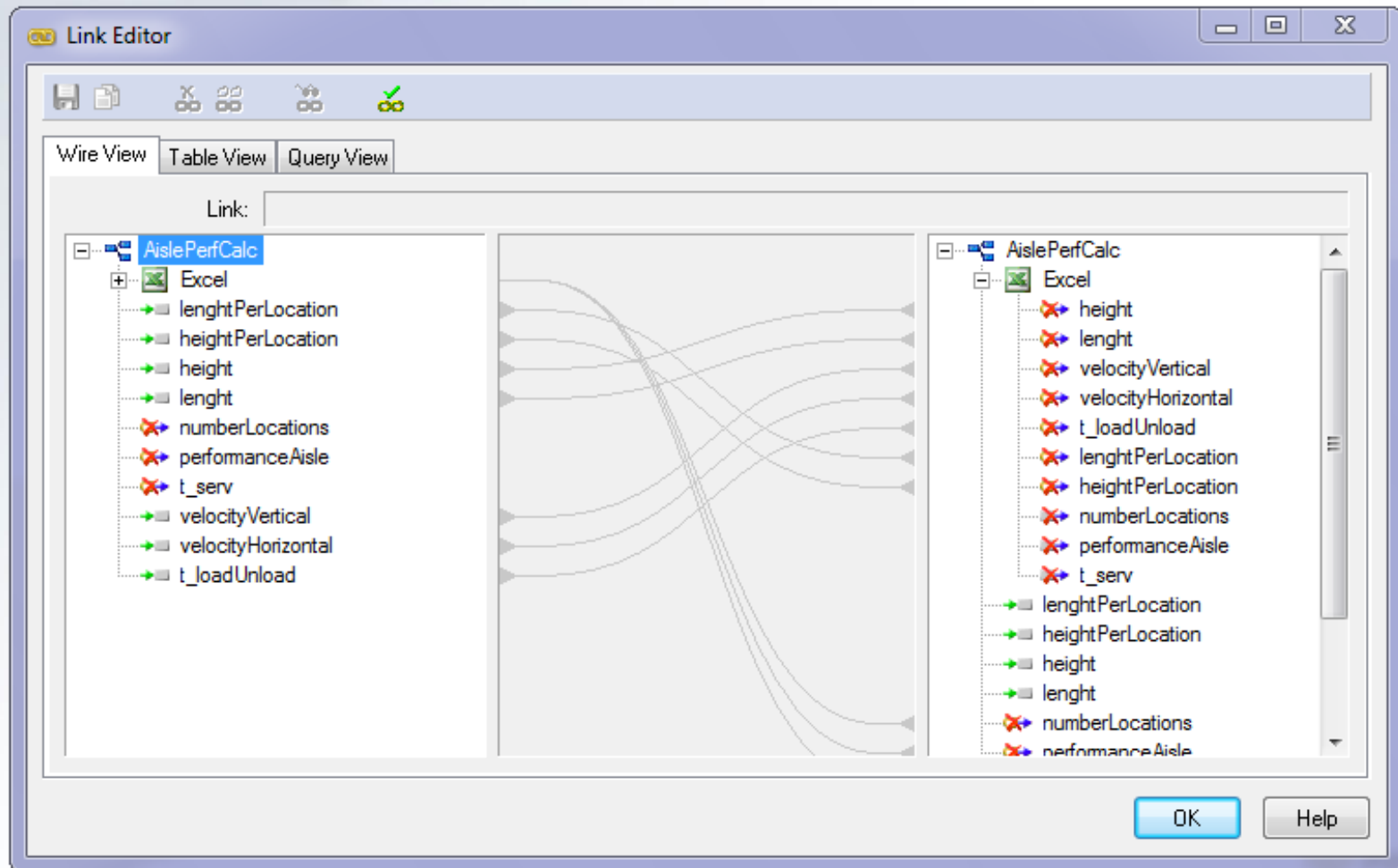Parametric Diagram

ModelCenter

Solver
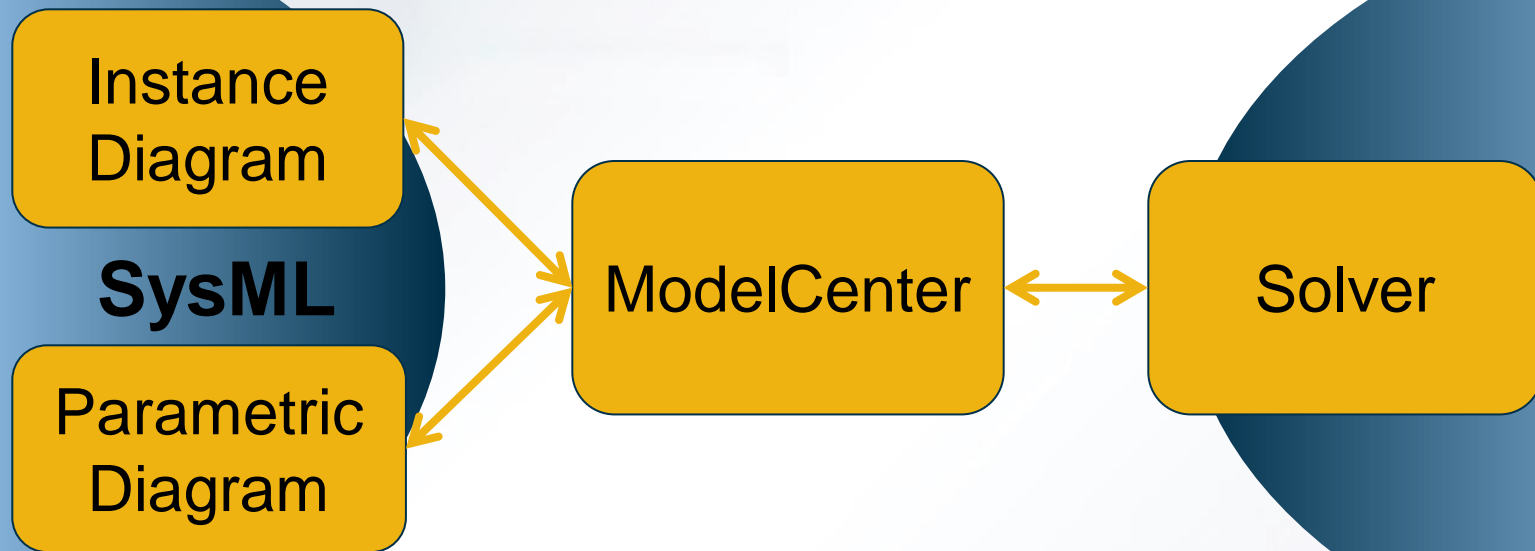
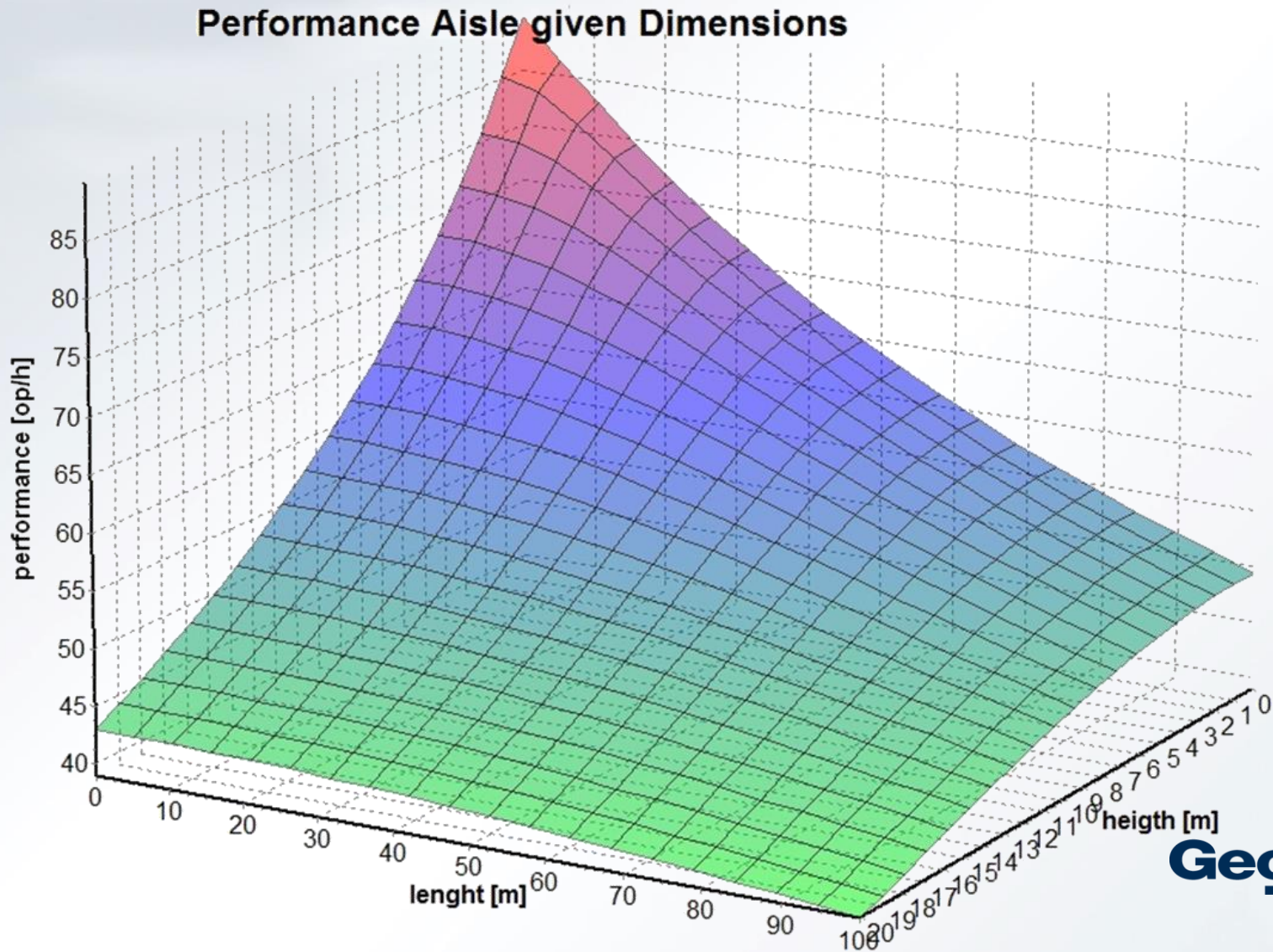**e.g. Excel, VB-Script,**

…

Parametric Diagram

Linkage in ModelCenter

Result

Conclusion & Future Work

We have:

- Basic function & implementation libraries
- Proposed design flow concept
- Experienced tool to include analysis

We would like to have:

- Demo of complete warehouse design
- Extension of libraries
- Inclusion of more analytical models

Georgia Tech

We are glad to answer your questions!

THANK YOU!

Georgia Tech